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METHODS OF CREATION OF HISTORICAL SITUATION PLAN CONCENTRATION CAMP “STALAG-328” (CITADEL) IN LVIV (UKRAINE) ON THE BASE ARCHIVAL AERIAL IMAGE

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Introduction

At this time in Ukraine there are a number of organizations that work in historical field on retrieval of historically decisive terrain objects. Some of them are working on the cultural heritage of different nations living on the territory of our country during World War II and most suffered at the Nazis occupation. But so happened that with the development of digital technology GIS tools can be used to reflect the former historical situation on the modern materials. One of the important historical objects of that time is Syretskiy concentration camp near Luk'yanivka in Kiev [3, 4]. Second according to importance and Nazi brutality concentration camp in Ukraine is a Stalag-328, situated in Lviv. Until now there was no situation plan that displace the processed information on the documentary for killed prisoners in the concentration camp and their mass graves.

The location of the concentration camp for the prisoners of war on the territory of the Citadel was the most tragic page in its history. At first (1941) there was “Stalag-328” where Soviet prisoners of war were kept under inhuman conditions [5].

The French and Belgian prisoners of war transferred from the closed concentration camp in Rava-Ruska (Ukraine) were kept there. Italian soldiers who refused to continue fighting on the side of Wermacht became the prisoners of the Citadel in the autumn of 1943.

At the Nurnberg process the mentioned number of killed prisoners of war during the period of concentration camp existence at the Citadel was 148, 000. After the war the buildings of the fortification complex were used as the barracks for Soviet soldiers. The entrance to the territory of the Citadel was closed [5].

The aim of this work is the interpretation of fragment archival aerial images of the Lviv during the World War II, which made in 1944 and joint processing of modern materials and archival aerial image using GIS tool.

The objective of the work was to find and research places of destruction and burial of prisoners of war by the Nazi; to display this places at the current plan of the Lviv; to analyze the results.

Searching the places of killings and mass graves of prisoners of war in concentration camp “Shtalag-328”

To achieve this goal the archival materials, which consisted of the testimony of eyewitnesses who were in concentration camp Stalag-328 during the World War II in Lviv and archival aerial image received by the Nazis in 1944 were analyzed.

Analysis of archival materials. At this stage the evidences of the destructions and burials, which were carried out by the Nazi taken from prisoners of concentration camp

Stalag-328 have been handled and compared with information from archival aerial image.

For researches there were used three plans: two archival concentration camp plans received by the Austrians before the war and postwar period by the Soviet military. The third was a plan created by Ukrainian surveyors in recent years. They are shown in Fig. 1, Fig. 2. and Fig.3.

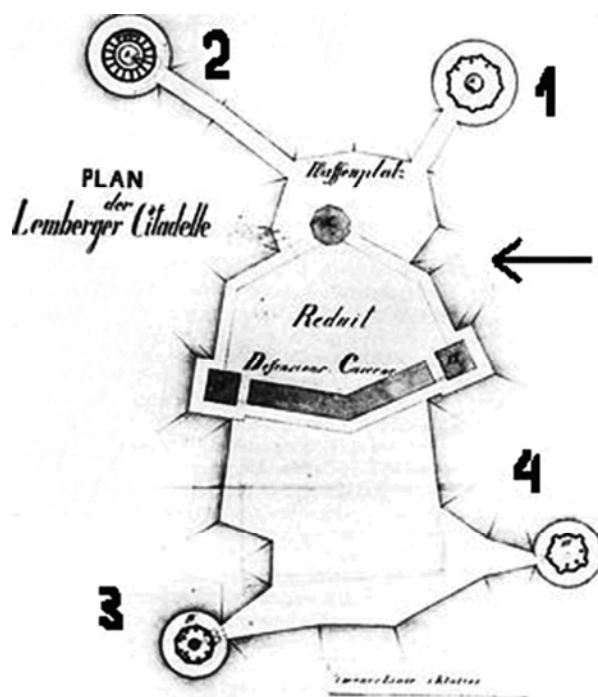


Fig. 1. Plan of the Citadel created by the Austrians

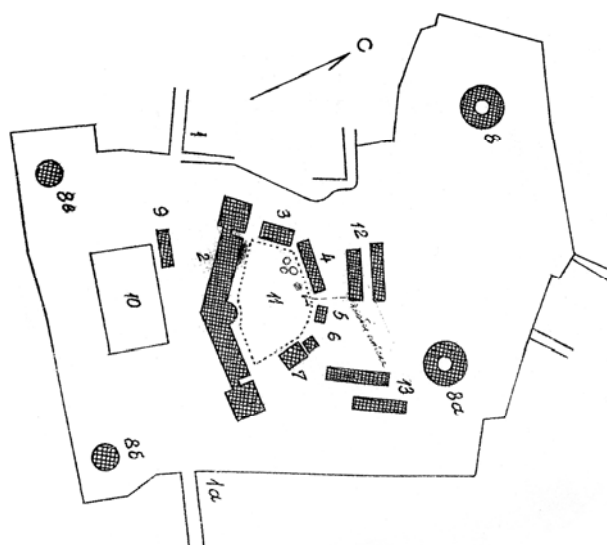


Fig. 2. Plan of the Citadel created by Soviet military

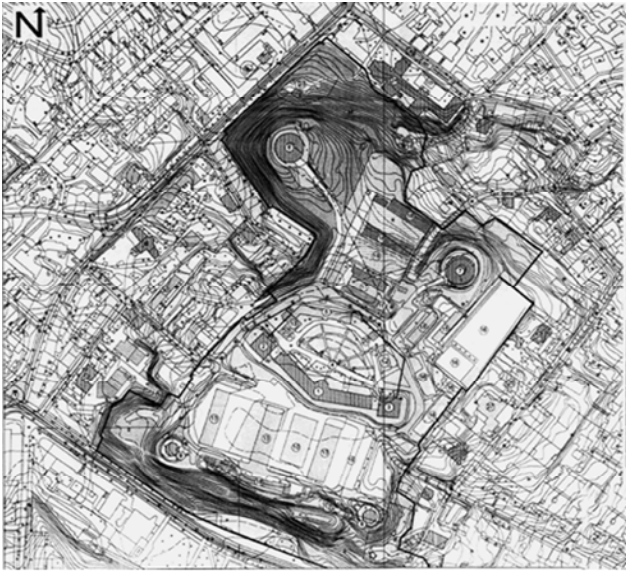


Fig. 3. Modern topographic plan of the Citadel area



Fig. 4. Archive aerial image made in 1944 by the Nazi

Transforming the Nazis archival aerial image. Since the archive image was quite high quality, but it was not transformed, as there was no data about the elements of orienteering.

For determination of objects that have remained since the war and were depicted on the archive image their coordinates were measured by GPS. Then using polynomial model the transformation of the image has been completed. Was used second-degree polynomial model [1]:

$$x = a_0 + a_1X + a_2Y + a_3X^2 + a_4XY + a_5X^2$$

$$y = b_0 + b_1X + b_2Y + b_3X^2 + b_4XY + b_5X^2$$

9 points identified on archival aerial image were used for transforming. It was impossible to find more contour points. After solving the equations the errors in the planned coordinates were obtained and the mean square errors have been calculated. They are $m_x = 4.0m, m_y = 2.7m$.

As we had to get a reviewing cartographic material, the question of accuracy in the classical sense is not relevant. For convenience the cartographic reproduction of object position it was printed in scale 1:1000. Transformed archival image [2] presented in Fig. 4.

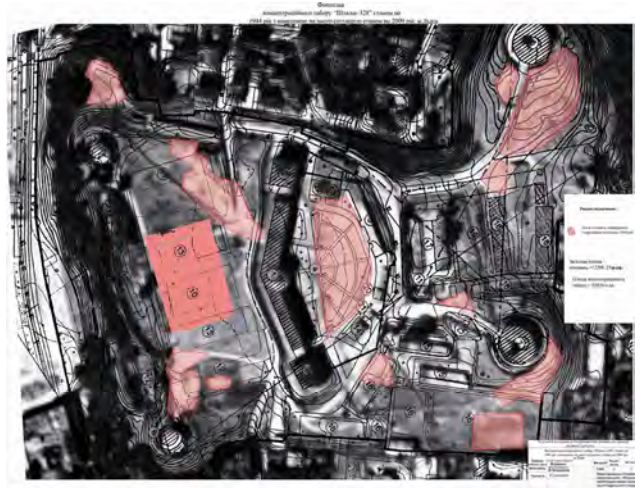


Fig. 5. The plan was created by combining archival aerial image with the modern topographic plan. The place of destructions and burial of prisoners of war on the base of interpretation and impressions of eyewitnesses was shown

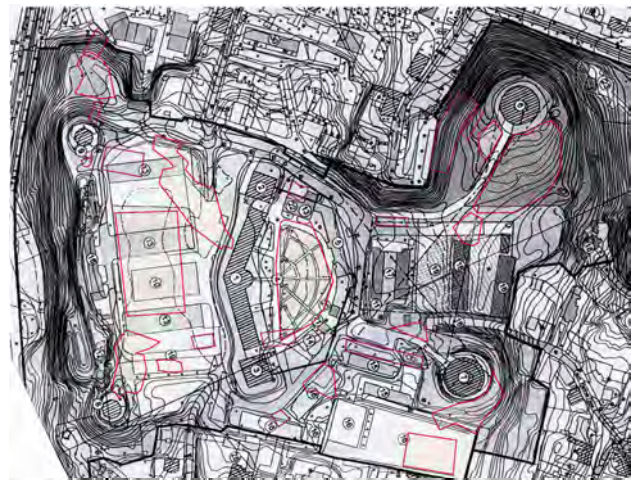


Fig. 6. Modern topographic plan with drawn places of destructions and burial of prisoners of war: red – interpreted with the aerial photographs; pink – obtained using land studies conducted in 2010

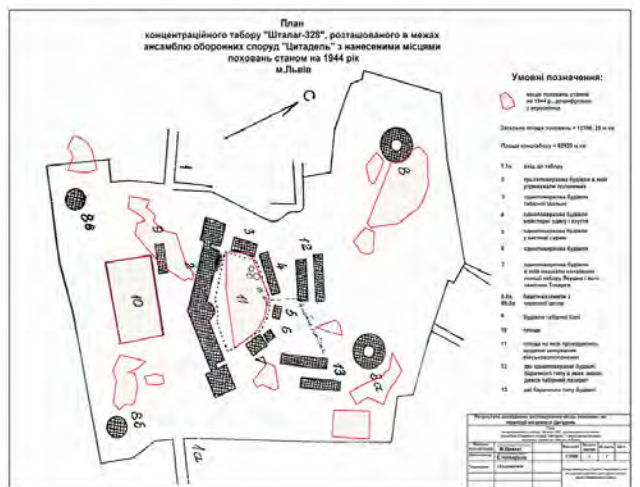


Fig. 7. Plan of the concentration camp of Shtalag-328 located within the fortification structures "Citadel" with drawn places of burial of prisoners of war

Processing of the archival image and vectorization interpreted objects of concentration camp in GIS Map Info. At this stage the task was to interpret and vectorize the territory of mass graves and killings of the concentration camp Stalag-328 on the transformed archival image, using data from the first stage. Using the software tool GIS Map Info the given territory, interpreted directly from aerial image was vectorized and the data about the same territory were obtained by means of land studies conducted in 2010 and saved in separate layers.

The combination of image of concentration camp Stalag-328 1943 with the modern urban situation. After we have received information from the vector layers on the location for killings and mass graves places of the concentration camp Stalag-328, it was necessary to determine how they are imposed on modern urban situation. For this Nazi archival image has been combined with topographic plan on this territory in recent years by using the transparency of individual color of raster image using GIS MapInfo. The result of these actions and the applied vector layer of territory executions are shown in Fig. 5.

Analysis of the contemporary buildings of historical objects. Analysis of this information, shows that 20 % of the area of mass graves discovered through research of concentration camp on the base archival materials was built up with some buildings and road network. The modern plan with drawn places mass graves shown in Fig. 6.

Receiving of processed graphic materials. At the final stage of this work it was necessary to unite all processed data and prepare the final situation plans of the concentration camp Stalag-328. Considering the large area of the camp it is expedient to use the A2 format. To perform this task, command "Report" were used in the software package MapInfo. Each of the plan variants was provided with legend and the title documentation.

Examples of the final result are shown in Fig. 7.

Conclusion

In the result of research two graphical documents, which describe the area of concentration camp Stalag-328 and its historical-important objects were developed and places of killing and mass graves of prisoners of the war were indicated.

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Методика створення історичного ситуаційного плану концентраційного табору "Stalag-328" (Цитадель) у Львові на основі архівних аерознімків Б. Четверіков, Л. Бабій

Розвиток цифрових технологій дає змогу використати ГІС-інструментарій для відображення історичної ситуації на сучасних картографічних матеріалах. Однією з важливих історичних пам'яток є концтабір "Шталаг -328", розташований на Цитаделі у м. Львові. В роботі інтерпретовано фрагмент архівного аерознімка м. Львова часів Другої світової війни, який отримано в 1944 р., і сумісно опрацьовано сучасне космічне зображення й архівні аерозображення за допомогою інструментарію ГІС. Сформовано план концентраційного табору з позначеними місцями розстрілів та масових поховань військовополонених.

Методика создания исторического ситуационного плана концентрационного лагеря "Stalag – 328" (Цитадель) во Львове на основании архивных аэроснимков Б. Четвериков, Л. Бабий

Развитие цифровых технологий позволяет использовать ГИС-инструментарий для отображения ситуации на современных картографических материалах. Одним из важных исторических памятников является концлагерь "Шталаг-328", расположенный на Цитадели во Львове. В работе интерпретировано фрагмент архивного аэроснимка г. Львова времён Второй мировой войны, который получен в 1944 г., совместно обработано современное космическое изображение и архивные аэроизображения с помощью инструментария ГИС. Получен план концентрационного лагеря с обозначенными местами расстрелов и массовых захоронений военнопленных.

Methods of creation of historical situation plan Concentration camp "Stalag-328" (Citadel) in Lviv (Ukraine) on the base archival aerial image B. Chetverikov, L. Babiy

It so happened that with the development of digital technology GIS tools can be used to display the historical situations on modern materials. One of the important historical sites of that time is the notorious concentration camp "Stalag-328", situated at the Citadel in Lviv. The aim of this work is the interpretation of fragment archival aerial image of Lviv during the World War II, which made by the Nazis in 1944, and compatible processing of contemporary space image, and archival aerial image using GIS tool.